Watershed Water Quality Assessment

Broad River Basin

Technical Report No. 001-01
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Prepared By

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PREFACE

In 1993, the South Carolina Department of Health and Environmental Control (SCDHEC) published the first in a series of five watershed management documents. The fifth in that series, Watershed Water Quality Management Strategy: Broad Basin communicated SCDHEC's innovative watershed approach, summarizing water programs and water quality in the basins. The approach continues to evolve and improve.

The watershed documents facilitate broader participation in the water quality management process. Through these publications, SCDHEC shares water quality information with internal and external partners, providing a common foundation for water quality improvement efforts at the local watershed or large-scale, often interstate, river basin level.

Water quality data from the Broad River Basin was collected and assessed at the start of this second five-year watershed management cycle. The assessment incorporates data from many more sites than were included in the first round. This updated atlas provides summary information on a watershed basis, as well as geographical presentations of all permitted watershed activities. A waterbody index and a facility index allow the reader to locate information on specific waters and facilities of interest.

A brief summary of the water quality assessments included in the body of this document is provided following the Table of Contents. This summary lists all waters within the Broad River Basin that fully support recreational and aquatic life uses, followed by those waters not supporting uses. In addition, the summaries list changes in use support status; those that have improved or degraded over the last five years since the original strategy was written. More comprehensive information can be found in the individual watershed sections. The information provided is accurate to the best of our knowledge at the time of writing and will be updated in five years.

General information on Broad River Basin Watershed Protection and Restoration Strategies can be found under that section on page 23, and more detailed information is located within the individual watershed evaluations.

As SCDHEC continues basinwide and statewide water quality protection and improvement efforts, we are counting on the support and assistance of all stakeholders in the Broad River Basin to participate in bringing about water quality improvements. We look forward to working with you.

If you have questions or comments regarding this document, or if you are seeking further information on the water quality in the Broad River Basin, please contact:

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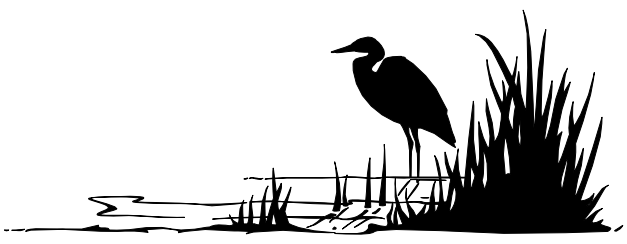

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Water Quality Assessment Summary

Broad River Basin

TERMS USED IN TABLES

AQUATIC LIFE USE SUPPORT (AL) - The degree to which aquatic life is protected is assessed by comparing important water quality characteristics and the concentrations of potentially toxic pollutants with standards. Aquatic life use support is based on the percentage of standards excursions at a sampling site.

For **dissolved oxygen** and **pH**:

If the percentage of standard excursions is 10 percent or less, then uses are ***fully supported***.

If the percentage of standard excursions is between 11-25 percent, then uses are ***partially supported***.

If the percentage of standard excursions is greater than 25 percent, uses are ***not supported*** (see p.11 for further information).

For **toxins** (heavy metals, priority pollutants, chlorine, ammonia):

If the acute aquatic life standard for any individual toxicant is not exceeded, uses are ***fully supported***.

If the acute aquatic life standard is exceeded more than once, but is less than or equal to 10 percent of the samples, uses are ***partially supported***.

If the acute aquatic life standard is exceeded in more than 10 percent of the samples, based on at least ten samples, aquatic life uses are ***not supported*** (see p.11 for further information).

RECREATIONAL USE SUPPORT (REC) - The degree to which the swimmable goal of the Clean Water Act is attained (recreational use support) is based on the frequency of fecal coliform bacteria excursions, defined as greater than 400/100 ml for all surface water classes.

If 10 percent or less of the samples are greater than 400/100 ml, then recreational uses are said to be ***fully supported***.

If the percentage of standards excursions is between 11-25%, then recreational uses are said to be ***partially supported***.

If the percentage of standards excursions is greater than 25%, then recreational uses are said to be ***nonsupported*** (see p.12 for further information).

Excursion - The term excursion is used to describe a measurement that does not comply with the appropriate water quality standard.

Table 1. Fully Supported Sites in the Broad River Basin

* = Station not evaluated for Recreational Support

Watershed	Waterbody Name	Station #	Improving Trends	Other Trends
03050108-010	Durbin Creek	BE-022*		
03050108-020	Cedar Shoals Creek	B-785*		
03050108-030	Warrior Creek	B-742*		
03050108-050	Indian Creek	B-071*		
	Kings Creek	B-799*		
03050107-010	Lake Cunningham	B-341		
	Maple Creek	B-625*		
	Bens Creek	B-782*		
	Ferguson Creek	B-787*		
	South Tyger River	B-741*		
		B-149	Decreasing BOD_5, Turbidity	Decreasing Dissolved Oxygen, pH
03050107-030	North Tyger River	B-017*		
03050107-040	Middle Tyger River	B-794*		
03050107-050	Jimmies Creek	B-786*		
	Dutchman Creek	B-733*		
	Cane Creek	B-777*		
03050107-060	Mitchell Creek	B-781*		
	Sugar Creek	B-779*		
03050105-050	Suck Creek	B-296*		

Table 1. Fully Supported Sites in the Broad River Basin

* = Station not evaluated for Recreational Support

Watershed	Waterbody Name	Station #	Improving Trends	Other Trends
03050105-090	Ross Creek	B-789*		
	Bowen River	B-788*		
	Lake Cherokee	B-343		
03050105-100	Buffalo Creek	B-740*		
03050105-130	Lake Thicketty	B-342		
03050105-140	Lake York	B-737		
	Long Branch	B-326		Increasing Total Phosphorus
	Clark Fork	B-325		Decreasing pH
		B-157*		
	Bullock Creek	B-739*		
03050105-150	Vaughn Creek	B-099-7*		
	Lake Lanier	B-099B	Decreasing BOD_5	Decreasing pH
	North Pacolet River	B-719*		
	Obed Creek	B-791*		
03050105-160	Spivey Creek	B-104*		
	South Pacolet River	B-720*		
	Lake Bowen	B-340		
		B-339		
	Spartanburg Reservoir #1	B-113	Decreasing BOD_5	Increasing Fecal Coliform

Table 1. Fully Supported Sites in the Broad River Basin

* = Station not evaluated for Recreational Support

Watershed	Waterbody Name	Station #	Improving Trends	Other Trends
03050105-170	Buck Creek	B-783*		
	Lake Blalock	B-347		
	Pacolet River	B-163A	Decreasing BOD_5	Increasing Total Phosphorus; Decreasing pH
03050105-180	Meadow Creek	B-531*		
03050106-010	Neal Creek	B-778*		
03050106-040	Chester State Park Lake	CL-023		
03050106-050	Cannons Creek	B-751*		
	Lake Monticello	B-328	Decreasing BOD_5, Total Nitrogen, Turbidity	Decreasing Dissolved Oxygen, pH
		B-327	Decreasing Total Nitrogen	
	Parr Reservoir	B-346		
		B-345		
03050106-060	Broad River	B-236	Decreasing Total Nitrogen	Increasing Turbidity

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
03050108-010	Beaverdam Creek	BE-039	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH
		B-796*	AL	PS	Macroinvertebrates		
	Buckhorn Creek	B-795*	AL	PS	Macroinvertebrates		
	Mountain Creek	B-186	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		BE-008*	AL	PS	Macroinvertebrates		
	Princess Creek	B-192	AL	NS	Zinc		Increasing pH
			REC	NS	Fecal Coliform	Increasing Fecal Coliform	
	Brushy Creek	BE-035	AL	PS	Macroinvertebrates		
			REC	NS[T]	Fecal Coliform		
		BE-009	AL	PS	Macroinvertebrates		
			REC	NS[T]	Fecal Coliform	Increasing Fecal Coliform	
	Rocky Creek	BE-007	AL	PS	Macroinvertebrates		
			REC	NS	Fecal Coliform		
	Abner Creek	B-792*	AL	PS	Macroinvertebrates		
	Horsepen Creek	B-793*	AL	PS	Macroinvertebrates		
	Gilder Creek	BE-040	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		B-241	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Increasing pH
		BE-020	AL	PS	Macroinvertebrates		Increasing pH
			REC	NS	Fecal Coliform	Increasing Fecal Coliform	

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
03050108-010	Lick Creek	B-038	REC	NS	Fecal Coliform		
	Durbin Creek	B-035	REC	NS	Fecal Coliform		
		B-097	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH
	Enoree River	BE-001	AL	NS	Zinc		Decreasing pH
			REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		B-797*	AL	PS	Macroinvertebrates		
		BE-015	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Increasing pH
		BE-017	AL	NS	Copper		Increasing pH
			REC	NS	Fecal Coliform		
		BE-018	AL	PS	Macroinvertebrates		
			REC	NS	Fecal Coliform		
		BE-019*	AL	PS	Macroinvertebrates		
		BE-037	REC	NS	Fecal Coliform		Decreasing pH
		BE-040	REC	PS	Fecal Coliform		
03050108-020	Enoree River	BE-041	AL	NS	Zinc		Decreasing pH
			REC	PS	Fecal Coliform		
		B-053	REC	NS	Fecal Coliform		
03050108-030	Beaverdam Creek	B-053	REC	NS	Fecal Coliform		
	Warrior Creek	B-150	REC	NS	Fecal Coliform		

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
03050108-040	Beards Fork Creek	B-231	AL	NS	Dissolved Oxygen		Decreasing pH
	Duncan Creek Reservoir	B-735	AL	PS	pH		
	Duncan Creek	B-072	REC	NS	Fecal Coliform		
03050108-050	Enoree River	B-054	AL	NS	Chromium		Decreasing Dissolved Oxygen; Increasing BOD_5, Turbidity
			REC	NS	Fecal Coliform		
03050107-010	Mush Creek	B-317	REC	NS	Fecal Coliform		
	Lake Robinson	CL-100	AL	PS	pH		
	South Tyger River	B-263	REC	PS	Fecal Coliform		Decreasing pH; Increasing Total Phosphorus, Turbidity
		B-005A*	AL	PS	Macroinvertebrates		
		B-005	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH; Increasing Total Phosphorus, Turbidity
		B-332	REC	PS	Fecal Coliform		
03050107-020	Lake Cooley	B-348	AL	PS	pH		
	North Tyger River Tributary	B-315	REC	NS	Fecal Coliform		Decreasing pH
	North Tyger River	B-219	AL	NS	Zinc		Decreasing Dissolved Oxygen pH; Increasing Turbidity
			REC	NS	Fecal Coliform		
03050107-030	North Tyger River	B-018A	REC	NS	Fecal Coliform		Decreasing Dissolved Oxygen; Increasing Total Phosphorus
03050107-040	Beaverdam Creek	B-784*	AL	PS	Macroinvertebrates		
03050107-040	Middle Tyger River	B-148	REC	NS^T	Fecal Coliform	Increasing Fecal Coliform	Increasing Turbidity

Table 2. Impaired Sites in the Broad River Basin

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Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
		B-012	REC	NS	Fecal Coliform		Decreasing pH
		B-014	REC	NS	Fecal Coliform		
03050107-050	Tyger River	B-008	REC	NS	Fecal Coliform		Decreasing Dissolved Oxygen, pH; Increasing Turbidity
		B-051	REC	NS	Fecal Coliform		Decreasing pH; Increasing Total Phosphorus
	Jimmies Creek	B-072	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH; Increasing Total Phosphorus
03050107-060	Fairforest Creek	B-020	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		B-164	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Increasing Total Phosphorus
		B-021	AL	NS	Macroinvertebrates, Chromium, Zinc Copper		B-219
			REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		BF-007	REC	NS	Fecal Coliform		
		BF-008	REC	NS	Fecal Coliform		Decreasing pH; Increasing Total Phosphorus
	Fairforest Creek Tributary	B-321	AL	NS	Chromium, Copper, Zinc		Decreasing pH
			REC	NS	Fecal Coliform	Increasing Fecal Coliform	
	Kelsey Creek	B-235	REC	NS	Fecal Coliform		Decreasing Dissolved Oxygen; pH
	Lake Johnson	CL-035	AL	NS	pH		
03050107-060	Lake Craig	CL-033	AL	PS	pH		
	Mitchell Creek	B-199	REC	NS	Fecal Coliform	Increasing Fecal Coliform	

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
	Toschs Creek	B-067A	REC	NS	Fecal Coliform		Decreasing pH
		B-067B	REC	NS	Fecal Coliform		Decreasing pH
	Tinkers Creek	B-286	REC	NS	Fecal Coliform		Decreasing pH; Increasing Total Phosphorus
		B-287	REC	NS	Fecal Coliform		
		B-336	REC	NS	Fecal Coliform		
03050105-090	Canoe Creek	B-088	AL	PS	Dissolved Oxygen		Decreasing pH
			REC	NS	Fecal Coliform		
	Peoples Creek	B-211	REC	NS	Fecal Coliform		Decreasing pH
	Furnace Creek	B-100	REC	NS	Fecal Coliform		
	Doolittle Creek	B-323	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH, Dissolved Oxygen
	Guyonmoore Creek	B-330	REC	PS	Fecal Coliform		
	Broad River	B-042	REC	PS	Fecal Coliform		Increasing Turbidity
	Broad River	B-044	REC	PS	Fecal Coliform		Increasing Turbidity
03050105-100	Buffalo Creek	B-119	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
		B-057	AL	PS	Copper	Increasing Fecal Coliform	
			REC	NS	Fecal Coliform		
03050105-110	Cherokee Creek	B-056	REC	NS	Fecal Coliform		Decreasing pH
03050105-110	Cherokee Creek	B-679*	AL	PS	Macroinvertebrates		
03050105-120	Kings Creek	B-333	REC	PS	Fecal Coliform		

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
03050105-130	Irene Creek	B-059	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH
	Limestone Creek	B-128	REC	NS	Fecal Coliform		Decreasing pH
	Gilkey Creek	B-334	REC	NS	Fecal Coliform		
	Thicketty Creek	B-095	REC	NS	Fecal Coliform		Decreasing pH
		B-133	REC	NS	Fecal Coliform		Decreasing pH
		B-062	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
03050105-140	Bullock Creek	B-159	REC	NS	Fecal Coliform	Increasing Fecal Coliform	
03050105-150	Lake Lanier	B-099A	REC	PS	Fecal Coliform		Decreasing Dissolved Oxygen; Increasing Turbidity
	Page Creek	B-301	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH
	North Pacolet River	B-026	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Decreasing Dissolved Oxygen, pH
		B-126	REC	NS	Fecal Coliform		
03050105-160	Spivey Creek	B-103	REC	PS	Fecal Coliform		Decreasing pH
	Motlow Creek	B-790*	AL	PS	Macroinvertebrates		
	South Pacolet River	B-302	REC	NS	Fecal Coliform		Decreasing pH
03050105-170	Little Buck Creek	B-259	REC	NS	Fecal Coliform		
	Potter Branch	B-191	REC	NS	Fecal Coliform		Decreasing pH
	Pacolet River	B-028	REC	NS	Fecal Coliform		
03050105-170	Pacolet River	B-331	REC	PS	Fecal Coliform		
03050105-180	Lawsons Fork Creek	B-221	AL	PS	Macroinvertebrates	Increasing Fecal Coliform	Increasing Total Phosphorus;

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
			REC	NS	Fecal Coliform		Decreasing pH
		B-277	REC	NS	Fecal Coliform		Increasing Total Phosphorus; Decreasing pH
		B-278	REC	NS	Fecal Coliform	Increasing Fecal Coliform	Increasing Total Phosphorus; Decreasing pH
		BL-005	REC	NS	Fecal Coliform		Increasing Total Phosphorus; Decreasing pH
		BL-001	AL	PS	Macroinvertebrates	Increasing Fecal Coliform	Increasing Total Nitrogen; Decreasing pH
			REC	NS	Fecal Coliform		
03050105-190	Mill Creek	B-780*	AL	PS	Macroinvertebrates		
	Pacolet River	BP-001	REC	NS	Fecal Coliform		Decreasing pH
		B-048	REC	NS	Fecal Coliform		
03050106-010	John D. Long Lake	B-344	AL	NS	pH		
	Broad River	B-046	REC	PS	Fecal Coliform		Decreasing pH
03050106-020	Ross Branch	B-086	REC	NS	Fecal Coliform		
	Turkey Creek	B-136	REC	PS	Fecal Coliform		
03050106-030	Meng Creek Tributary	B-243	REC	NS	Fecal Coliform		
	Meng Creek	B-064	REC	NS	Fecal Coliform		Decreasing pH
	Browns Creek	B-155	REC	PS	Fecal Coliform		
03050106-030	Gregorys Creek	B-335	REC	NS	Fecal Coliform		
03050106-040	Dry Fork	B-074	REC	NS	Fecal Coliform		Decreasing pH

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
	Sandy River	B-075	REC	NS	Fecal Coliform		Decreasing pH
03050106-050	Broad River	B-047	REC	PS	Fecal Coliform		
	Gregorys Creek	B-074	REC	PS	Fecal Coliform		Increasing Turbidity
	Heller Creek	B-151*	AL	PS	Macroinvertebrates		
03050106-060	Crims Creek	B-800*	AL	PS	Macroinvertebrates		
	Wateree Creek	B-801*	AL	PS	Macroinvertebrates		
	Elizabeth Lake	B-110*	REC	PS	Fecal Coliform	Increasing Fecal Coliform	Decreasing pH
	Cranes Creek	B-081*	AL	PS	Macroinvertebrates		
		B-316	AL	NS	Zinc		
			REC	PS	Fecal Coliform		
	Smith Branch	B-280	AL	NS	Macroinvertebrates, Zinc		Increasing Total Phosphorus
			REC	NS	Fecal Coliform		
	Broad River	B-337	REC	PS	Fecal Coliform		
		B-080	AL	NS	Copper		
			REC	PS	Fecal Coliform		
03050106-070	Little River	B-145	REC	NS	Fecal Coliform		
03050106-080	Winnsboro Branch	B-123	REC	NS	Fecal Coliform		
03050106-080	Winnsboro Branch	B-077	AL	NS	Copper, Zinc		Increasing Total Phosphorus
			REC	NS	Fecal Coliform		

Table 2. Impaired Sites in the Broad River Basin

REC=Recreational; AL=Aquatic Life; PS=Partially Supported Standards; NS=Nonsupported Standards; *=Station not evaluated for Recreational Support; T=TMDL Developed

Watershed	Waterbody Name	Station #	Use	Status	Water Quality Indicator	Undesirable Trends	Other Trends
	Jackson Creek	B-102	AL	PS	Macroinvertebrates		
			REC	PS	Fecal Coliform		
	Mill Creek	B-338	REC	NS	Fecal Coliform		
03050106-090	Big Cedar Creek	B-320	REC	PS[T]	Fecal Coliform		

Table 3. Changes in Use Support Status

Broad River Basin Sites that Improved from 1995 to 1999

REC= Recreational; AL=Aquatic Life; FS=Fully Supported Standards; PS=Partially Supported Standards; NS=Nonsupported Standards

Watershed	Waterbody Name	Station #	Use	Status		Water Quality Indicator	
				1995	1999	1995	1999
03050108-020	Enoree River	B-041	REC	NS	PS	Fecal Coliform	Fecal Coliform
03050108-040	Beards Fork Creek	B-231	REC	PS	FS	Fecal Coliform	
03050107-010	South Tyger River	B-263	REC	NS	PS	Fecal Coliform	Fecal Coliform
03050107-050	Tyger River	B-051	AL	NS	FS	Zinc	
03050107-060	Fairforest Creek	BF-007	AL	PS	FS	Dissolved Oxygen	
03050105-090	Broad River	B-044	AL	NS	FS	Cadmium, Lead, Chromium, Zinc, Copper	
03050105-140	Long Branch	B-326	REC	PS	FS	Fecal Coliform	
	Clark Fork	B-325	REC	PS	FS	Fecal Coliform	
03050105-170	Pacolet River	B-163A	REC	PS	FS	Fecal Coliform	
		B-331	REC	NS	PS	Fecal Coliform	Fecal Coliform
03050106-060	Crane Creek	B-316	REC	NS	PS	Fecal Coliform	Fecal Coliform
	Broad River	B-236	REC	PS	FS	Fecal Coliform	
03050106-080	Jackson Creek	B-102	REC	NS	PS	Fecal Coliform	Fecal Coliform

Table 4. Changes in Use Support Status

Broad River Basin Sites that Degraded from 1995 to 1999

REC= Recreational; AL=Aquatic Life; FS=Fully Supported Standards; PS=Partially Supported Standards; NS=Nonsupported Standards

Watershed	Waterbody Name	Station #	Use	Status		Water Quality Indicator	
				1995	1999	1995	1999
03050108-010	Princess Creek	B-192	REC	PS	NS	Fecal Coliform	Fecal Coliform
	Brushy Creek	BE-009	AL	FS	PS		Macroinvertebrates
	Rocky Creek	BE-007	AL	FS	PS		Macroinvertebrates
	Gilder Creek	BE-020	AL	FS	PS		Macroinvertebrates
	Enoree River	BE-001	REC	PS	NS	Fecal Coliform	Fecal Coliform
		BE-017	AL	PS	NS	Copper	Copper
		B-037	REC	PS	NS	Fecal Coliform	Fecal Coliform
03050108-020	Enoree River	B-041	AL	FS	NS		Zinc
03050108-040	Beards Fork Creek	B-231	AL	PS	NS	Dissolved Oxygen	Dissolved Oxygen
	Duncan Creek Reservoir 6B	B-735	AL	FS	PS		pH
03050108-050	Enoree River	B-054	AL	FS	NS		Chromium
03050107-010	Mush Creek	B-317	REC	PS	NS	Fecal Coliform	Fecal Coliform
	South Tyger River	B-005	REC	PS	NS	Fecal Coliform	Fecal Coliform
		B-332	REC	FS	PS		Fecal Coliform
03050107-020	Lake Cooley	B-348	AL	FS	PS		pH
	North Tyger River	B-219	AL	PS	NS	Zinc	Zinc
03050107-060	Lake Johnson	CL-035	AL	FS	NS		pH
	Lake Craig	CL-033	AL	FS	NS		pH
	Fairforest Creek	BF-007	REC	PS	NS	Fecal Coliform	Fecal Coliform
		BF-008	REC	PS	NS	Fecal Coliform	Fecal Coliform
03050105-090	Broad River	B-044	REC	PS	NS	Fecal Coliform	Fecal Coliform
03050106-010	Lake John D. Long	B-344	AL	FS	NS		pH
03050106-020	Turkey Creek	B-136	REC	FS	PS		Fecal Coliform
03050106-030	Gregorys Creek	B-335	REC	FS	PS		Fecal Coliform
03050106-060	Elizabeth Lake	B-110	AL	FS	PS		pH
	Broad River	B-337	REC	FS	PS		Fecal Coliform
03050106-080	Winnsboro Branch	B-077	AL	FS	NS		Copper, Zinc

Introduction

The South Carolina Department of Health and Environmental Control (SCDHEC or the Department) initiated its first watershed planning activities as a result of a U.S. Environmental Protection Agency (USEPA) grant in June of 1972. These activities were soon extended by requirements for a Continuing Planning Process under '303(e), "Federal Water Pollution Control Act Amendments of 1972", U.S. Public Law 92-500. In 1975, the SCDHEC published basin-planning reports for the four major basins in South Carolina. Watershed assessments are updated every five years for all river basins in the state. A related planning activity resulted from '208 of the Federal Water Pollution Control Act, which required states to prepare planning documents on an areawide basis. Areawide plans were completed in the late 1970's for the five designated areas of the State and for the nondesignated remainder of the State. To date, these plans or their updated versions have served as information sources and guides for water quality management. The Continuing Planning Process, watershed assessments, and 208 plans are elements of South Carolina's overall water quality management plan.

The Bureau of Water emphasizes watershed planning to better coordinate river basin planning and water quality management. Watershed-based management allows the Department to address Congressional and Legislative mandates in a coordinated manner and to better utilize current resources. The watershed approach also improves communication between the Department, the regulated community, and the public on existing and future water quality issues.

Purpose of the Watershed Water Quality Assessment

A watershed is a geographic area into which the surrounding waters, sediments, and dissolved materials drain, and whose boundaries extend along surrounding topographic ridges. Watershed-based water quality management recognizes the interdependence of water quality related activities associated with a drainage basin including: monitoring, problem identification and prioritization, water quality modeling, planning, permitting, and other activities. The Bureau of Water's Watershed Water Quality Management Program integrates these activities by watershed, resulting in watershed management plans that appropriately focus water quality protection efforts. While an important aspect of the program is water quality problem identification and solution, the emphasis is on problem prevention.

The Department has divided the State into five regions (areas consisting of one or more river basins), along hydrologic lines, which contain approximately the same number of NPDES permitted dischargers. A Watershed Water Quality Assessment (WWQA) will be created for each river basin within the five regions and will be updated on a five-year rotational basis. This will allow for effective allocation and coordination of water quality activities and efficient use of available resources. The Broad River Basin is subdivided into 32 watersheds or hydrologic units within the State of South Carolina. Within the Department=s Broad Basin are the Enoree River Basin, the Tyger River Basin, and the Broad River Basin. The hydrologic units used are the USDA Natural Resource Conservation Service 11-digit codes for South Carolina. All water quality related evaluations will be made at the watershed level. The stream names used are derived from USGS topographic maps. USEPA Reach data (RF3) were used for the digital hydrography and stream length estimates. Based on the blue line streams of the USGS topo

maps, it is likely that portions of the stream network in terms of perennial, intermittent, and ephemeral streams are not represented.

The watershed-based assessments fulfill a number of USEPA reporting requirements including various activities under '303(d), '305(b), '314, and '319 of the Clean Water Act (CWA). Section 303(d) requires a listing of waters located within a watershed that do not meet applicable water quality standards. Section 305(b) requires that the State biennially submit a report that includes a water quality description and analysis of all navigable waters to estimate environmental impacts. Section 314 requires that the State submit a biennial report that identifies, classifies, describes, and assesses the status and trends in water quality of publicly owned lakes. The watershed plan is also a logical evaluation, prioritization, and implementation tool for nonpoint source ('319) requirements. Nonpoint source best management practices (BMPs) can be selected by identifying water quality impairments and necessary controls, while considering all the activities occurring in the drainage basin.

The assessment also allows for more efficient issuance of National Pollutant Discharge Elimination System (NPDES) and State wastewater discharge permits. Proposed permit issuances within a watershed may be consolidated and presented to the public in groups, rather than one at a time, allowing the Department to realize a resource savings, and the public to realize an information advantage.

The Watershed Water Quality Assessment (WWQA) is a geographically-based document that describes, at the watershed level, all water quality related activities that may potentially have a negative impact on water quality. The Watershed Implementation Staff investigates the impaired streams mentioned in the WWQA to determine, where possible, the source of the impairment and recommends solutions to correct the problems. As part of this effort, the watershed staff is forging partnerships with various federal and state agencies, local governments, and community groups. In particular, the Department's Watershed Program and the Natural Resource Conservation Service (NRCS) district offices are working together to address some of the nonpoint source (NPS) concerns in the basin. By combining NRCS's local knowledge of land use and the Department's knowledge of water quality, we are able to build upon NRCS's close relationships with landowners and determine where NPS projects are needed. These projects may include educational campaigns or special water quality studies.

Factors Assessed in Watershed Evaluations

Water Quality

The Water Program comprises activities within SCDHEC's Bureau of Water and Bureau of Environmental Services. The Program's objectives are to ensure that the water in South Carolina is safe for drinking and recreation, and that it is suitable to support and maintain aquatic flora and fauna. Functions include planning, permitting, compliance assurance, enforcement, and monitoring. This section provides an overview of water quality evaluation and protection activities.

Monitoring

In an effort to evaluate the State's water quality, the Department operates and collects data from a permanent statewide network of primary and secondary ambient monitoring stations and flexible, rotating watershed monitoring stations. The ambient monitoring network is directed toward determining long-term water quality trends, assessing attainment of water quality standards, identifying locations in need of additional attention, and providing background data for planning and evaluating stream classifications and standards.

Ambient monitoring data are also used in the process of formulating permit limits for wastewater discharges with the goal of maintaining State and Federal water quality standards and criteria in the receiving streams in accordance with the goals of the Clean Water Act. These standards and criteria define the instream chemical concentrations that provide for protection and reproduction of aquatic flora and fauna, help determine support of the classified uses of each waterbody, and serve as instream limits for the regulation of wastewater discharges or other activities. In addition, these data are used in the preparation of the biennial '305(b) report to Congress, which summarizes the State's water quality with respect to attainment of classified uses by comparing the ambient monitoring network data to the State Water Quality Standards.

SCDHEC=s ambient water quality monitoring network comprises four station types: primary (P), secondary (S), watershed (W), and biological (BIO) stations. These station types are listed in the site descriptions preceding the water quality information in each watershed and in the Appendices under Ambient Water Quality Monitoring Site Descriptions. Not all parameters are collected at every site. Primary stations are sampled on a monthly basis year round, and are located in high water-use areas or upstream of high water-use areas. The static primary station network is operated statewide, and receives the most extensive parameter coverage, thus making it best suited for detecting long-term trends.

Secondary stations are sampled monthly from May through October, a period critical to aquatic life, and is characterized by higher water temperatures and lower flows. Secondary stations are located in areas where specific monitoring is warranted due to point source discharges, or in areas with a history of water quality problems. Secondary station parameter coverage is less extensive and more flexible than primary or watershed station coverages. The number and locations of secondary stations have greater annual variability than do those in the primary station network, and during a basin's target year may have parameter coverage and sampling frequency duplicating that of primary or watershed stations.

Watershed stations are sampled on a monthly basis, year round, during a basin's target year. Additional watershed stations may be sampled monthly from May through October to augment the secondary station network. Watershed stations are located to provide more complete and representative coverage within the larger drainage basin, and to identify additional monitoring needs. Watershed stations have the same parameter coverage as primary stations.

Ambient trend monitoring, utilizing biological stations, is conducted to collect data to indicate general biological conditions of State waters that may be subject to a variety of point and nonpoint source impacts. In 1991, the Department began incorporating ambient macroinvertebrate data into the development of Watershed Water Quality Assessments. Ambient sampling is also used to establish regional reference or "least impacted" sites from which to make comparisons in future monitoring. Additionally, special macroinvertebrate studies, in which stream specific comparisons among stations located upstream and downstream from a known discharge or nonpoint source area, are used to assess impact.

Qualitative sampling of macroinvertebrate communities is the primary bioassessment technique used in ambient trend monitoring. A habitat assessment of general stream habitat availability and a substrate characterization is conducted at each site. Annual ambient monitoring is conducted during low flow "worst case" conditions in July - September. Some coastal plain streams that have no flow conditions in the summer months may be sampled in the winter (January-March). This technique may also be used in special studies for the purpose of determining if, and to what extent, a wastewater discharge or nonpoint source runoff is impacting the receiving stream. A minimum of two sample locations, one upstream and one downstream from a discharge or runoff area, is collected. At least one downstream recovery station is also established when appropriate. Sampling methodology follows procedures described in Standard Operating Procedures, Biological Monitoring. Only sites described as ‘BIO’ will collect information on the macroinvertebrate communities used in the ambient trend monitoring.

Many pollutants may be components of point source discharges, but may be discharged in a discontinuous manner, or at such low concentrations that water column sampling for them is impractical. Some pollutants are also common in nonpoint source runoff, reaching waterways only after a heavy rainfall; therefore, in these situations, the best media for the detection of these chemicals are sediment and fish tissue where they may accumulate over time. Their impact may also affect the macroinvertebrate community.

Aquatic sediments represent a historical record of chronic conditions existing in the water column. Pollutants bind to particulate organic matter in the water column and settle to the bottom where they become part of the sediment "record". Accumulated sediments not only reflect the impact of point source discharges, but also incorporate nonpoint source pollution washed into the stream during rain events. As a result, contaminant concentrations originating from irregular and highly variable sources are recorded in the sediment. The sediment concentrations at a particular location do not vary as rapidly with time as do the water column concentrations. Thus, the sediment record may be read at a later time, unrelated to the actual release time. Lakes act as settling basins for materials entering the lake system directly from a discharge or indirectly from the land surface washed into streams. Therefore, it is not

unusual for lake sediment concentrations to be higher than sediment concentrations found in streams. This is especially true for chromium, copper, and zinc.

The ambient monitoring program has the capability of sampling a wide range of media and analyzing them for the presence or effects of contaminants. Ambient monitoring data from 25 primary (P) stations, 73 secondary (S) stations, 34 watershed (W) stations, and 68 biological (BIO) stations were reviewed for the Broad River Basin.

Classified Waters, Standards, and Natural Conditions

The waters of the State have been classified in regulation based on the desired uses of each waterbody. State standards for various parameters have been established to protect all uses within each classification. For a more detailed explanation of water classifications and standards, see South Carolina Regulation 61-68. The water-use classifications that apply to this basin are as follows.

Class ORW, or "outstanding resource waters", are freshwaters or saltwaters that constitute an outstanding recreational or ecological resource, or those freshwaters suitable as a source for drinking water supply purposes, with treatment levels specified by the Department.

Class A were freshwaters that were suitable for primary contact recreation. This class was also suitable for uses listed as Class B. As of April 1992, Class A and Class B waters were reclassified as Class FW, which protects for primary contact recreation.

Class B were freshwaters that were suitable for secondary contact recreation and as a source for drinking water supply, after conventional treatment, in accordance with the requirements of the Department. These waters were suitable for fishing, and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. This class was also suitable for industrial and agricultural uses. The main difference between the Class A and B freshwater was the fecal coliform standard. Class A waters were not to exceed a geometric mean of 200/100ml, based on 5 consecutive samples during any 30 day period; nor were more than 10% of the total samples during any 30 day period to exceed 400/100ml. Class B waters were not to exceed a geometric mean of 1000/100ml, based on 5 consecutive samples during any 30 day period; nor were more than 20% of the total samples during any 30 day period to exceed 2000/100ml. As of April 1992, Class A and Class B waters were reclassified as Class FW, which protects for primary contact recreation.

Class FW, or "freshwaters", are freshwaters that are suitable for primary and secondary contact recreation and as a source for drinking water supply, after conventional treatment, in accordance with the requirements of the Department. These waters are suitable for fishing, and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. This class is also suitable for industrial and agricultural uses.

Site specific numeric standards (*) for surface waters may be established by the Department to replace the numeric standards found in Regulation 61-68 or to add new standards not contained in R.61-68. Establishment of such standards shall be subject to public participation and administrative procedures for adopting regulations. In addition, such site specific numeric standards shall not apply to tributary or downstream waters unless specifically described in the water classification listing in R.61-69.

The standards are used as instream water quality goals to maintain and improve water quality and also serve as the foundation of the Bureau of Water's program. They are used to determine permit limits for treated wastewater dischargers and any other activities that may impact water quality. Using mathematical Wasteload Allocation Models, the impact of a wastewater discharge on a receiving stream

is predicted. For free flowing streams, 7Q10 is defined as the critical low flow. For highly regulated streams and tidal streams, other more appropriate critical flows may be determined. These predictions are then used to set limits for different pollutants on the National Pollutant Discharge Elimination System (NPDES) permits issued by the Department. The NPDES permit limits are set so that, as long as a permittee (wastewater discharger) meets the established permit limits, the discharge should not cause a standards violation in the receiving stream. All discharges to the waters of the State are required to have an NPDES permit and must abide by those limits, under penalty of law.

Classifications are based on desired uses, not on natural or existing water quality, and are a legal means to obtain the necessary treatment of discharged wastewater to protect designated uses. Actual water quality may not have a bearing on a waterbody's classification. A waterbody may be reclassified if desired or existing public uses justify the reclassification and the water quality necessary to protect these uses is attainable. A classification change is an amendment to a State regulation and requires public participation, SCDHEC Board approval, and General Assembly approval.

Natural conditions may prevent a waterbody from meeting the water quality goals as set forth in the standards. The fact that a waterbody does not meet the specified numeric standards for a particular classification does not mean the waterbody is polluted or of poor quality. Certain types of waterbodies (ie. swamps, lakes, tidal creeks) may naturally have water quality lower than the numeric standards. A waterbody can have water quality conditions below standards due to natural causes and still meet its use classification. A site specific numeric standard may be established by the Department after being subjected to public participation and administrative procedures for adopting regulations. Site specific numeric standards apply only to the stream segment described in the water classification listing, not to tributaries or downstream unspecified waters.

Lake Trophic Status

Trophic status is a characterization of a lake's biological productivity based on the availability of plant nutrients, especially phosphorus. Commonly accepted systems for describing trophic status recognize a range of conditions, with "oligotrophic" indicating the least biologically productive lakes and "eutrophic" indicating significantly higher levels of productivity. A lake's trophic condition may shift over time. The trophic condition of South Carolina lakes is monitored through SCDHEC=s network of routine sampling stations and through periodic sampling of additional lakes. All lakes of at least 40 acres in area that offer public access are monitored.

Most commonly, large external inputs of nutrients from point and/or nonpoint sources lead to advanced eutrophication. Advanced eutrophication is indicated by excessive algal growth, rapid sedimentation, and seasonal or daily dissolved oxygen deficiencies. Advanced eutrophication can cause undesirable shifts in the composition of aquatic life, or even fish kills. Restoring a lake to a more desirable trophic condition requires reductions in nutrient inputs, usually phosphorus.

Water Quality Indicators

Water quality data are used to describe the condition of a waterbody, to help understand why that condition exists, and to provide some clues as to how it may be improved. Water quality indicators

include physical, chemical, and biological measurements. Copies of the Standard Operating Procedures used for these measurements are available from the Department's Bureau of Water and the Bureau of Environmental Services. The current State of S.C. Monitoring Strategy is available on our website at www.scdhec.net/eqc/admin/html/eqcpubs.html#wqreports and describes what parameters are sampled, where they are sampled, and how frequently.

MACROINVERTEBRATE COMMUNITY

Macroinvertebrates are aquatic insects and other aquatic invertebrates associated with the substrates of waterbodies (including, but not limited to, streams, rivers, tidal creeks, and estuaries). Macroinvertebrates can be useful indicators of water quality because these communities respond to integrated stresses over time that reflect fluctuating environmental conditions. Community responses to various pollutants (e.g. organic, toxic, and sediment) may be assessed through interpretation of diversity, known organism tolerances, and in some cases, relative abundances and feeding types.

FISH TISSUE

Many pollutants occur in such low concentrations in the water column that they are usually below analytical detection limits. Over time many of these chemicals may accumulate in fish tissue to levels that are easily measured. By analyzing fish tissue it is possible to see what pollutants may be present in waterbodies at very low levels. This information can also be used to determine if consumption of the fish poses any undue human health concerns and to calculate consumption rates that are safe.

DISSOLVED OXYGEN

Oxygen is essential for the survival and propagation of aquatic organisms. If the amount of oxygen dissolved in water falls below the minimum requirements for survival, aquatic organisms or their eggs and larvae may die. A severe example is a fish kill. Dissolved oxygen (DO) varies greatly due to natural phenomena, resulting in daily and seasonal cycles. Different forms of pollution also can cause declines in DO.

Changes in DO levels can result from temperature changes or the activity of plants and other organisms present in a waterbody. The natural diurnal (daily) cycle of DO concentration is well documented. Dissolved oxygen concentrations are generally lowest in the morning, climbing throughout the day due to photosynthesis and peaking near dusk, then steadily declining during the hours of darkness.

There is also a seasonal DO cycle in which concentrations are greater in the colder, winter months and lower in the warmer, summer months. Streamflow (in freshwater) is generally lower during the summer and fall, and greatly affects flushing, reaeration, and the extent of saltwater intrusion, all of which affect dissolved oxygen values.

BIOCHEMICAL OXYGEN DEMAND

Five-day biochemical oxygen demand (BOD_5) is a measure of the amount of dissolved oxygen consumed by the decomposition of carbonaceous and nitrogenous matter in water over a five-day period. The BOD_5 test indicates the amount of biologically oxidizable carbon and nitrogen that is present in

wastewater or in natural water. Matter containing carbon or nitrogen uses dissolved oxygen from the water as it decomposes, which can result in a dissolved oxygen decline. The quantity of BOD_5 discharged by point sources is limited through the National Pollutant Discharge Elimination System (NPDES) permits issued by the Department. The discharge of BOD_5 from a point source is restricted by the permits so as to maintain the applicable dissolved oxygen standard.

pH

pH is a measure of the hydrogen ion concentration of water, and is used to indicate degree of acidity. The pH scale ranges from 0 to 14 standard units (SU). A pH of 7 is considered neutral, with values less than 7 being acidic, and values greater than 7 being basic.

Low pH values are found in natural waters rich in dissolved organic matter, especially in Coastal Plain swamps and black water rivers. The tannic acid released from the decomposition of vegetation causes the tea coloration of the water and low pH.

High pH values in lakes during warmer months are associated with high phytoplankton (algae) densities. The relationship between phytoplankton and daily pH cycles is well established. Photosynthesis by phytoplankton consumes carbon dioxide during the day, which results in a rise in pH. In the dark, phytoplankton respiration releases carbon dioxide. In productive lakes, carbon dioxide decreases to very low levels, causing the pH to rise to 9-10 SU. Continuous flushing in streams prevents the development of significant phytoplankton populations and the resultant chemical changes in water quality.

Fecal Coliform Bacteria

Coliform bacteria are present in the digestive tract and feces of all warm-blooded animals, including humans, poultry, livestock, and wild animal species. Fecal coliform bacteria are themselves generally not harmful, but their presence indicates that surface waters may contain pathogenic microbes. Diseases that can be transmitted to humans through water contaminated by improperly treated human or animal waste are the primary concern. At present, it is difficult to distinguish between waters contaminated by animal waste and those contaminated by human waste.

Public health studies have established correlations between fecal coliform numbers in recreational and drinking waters and the risk of adverse health effects. Based on these relationships, the USEPA and SCDHEC have developed enforceable standards for surface waters to protect against adverse health effects from various recreational or drinking water uses. Proper waste disposal or sewage treatment prior to discharge to surface waters minimizes this type of pollution.

Nutrients

Oxygen demanding materials and plant nutrients are common substances discharged to the environment by man's activities, through wastewater facilities and by agricultural, residential, and stormwater runoff. The most important plant nutrients, in terms of water quality, are phosphorus and nitrogen. In general, increasing nutrient concentrations are undesirable due to the potential for accelerated growth of aquatic plants, including algae. Nuisance plant growth can create imbalances in the

aquatic community, as well as aesthetic and access issues. High densities of phytoplankton (algae) can cause wide fluctuations in pH and dissolved oxygen.

The forms of nitrogen routinely analyzed at SCDHEC stations are ammonia and ammonium nitrogen (NH_3/NH_4), total Kjeldahl nitrogen (TKN), and nitrite and nitrate nitrogen (NO_2/NO_3). Ammonia and ammonium are readily used by plants. TKN is a measure of organic nitrogen and ammonia in a sample. Nitrate is the product of aerobic transformation of ammonia, and is the most common form used by aquatic plants. Nitrite is usually not present in significant amounts.

Total phosphorus (TP) is commonly measured to determine phosphorus concentrations in surface waters. TP includes all of the various forms of phosphorus (organic, inorganic, dissolved, and particulate) present in a sample.

TURBIDITY

Turbidity is an expression of the scattering and absorption of light through water. The presence of clay, silt, fine organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms increases turbidity. Increasing turbidity can be an indication of increased runoff from land. It is an important consideration for drinking water as finished water has turbidity limits.

TOTAL SUSPENDED SOLIDS

Total Suspended Solids (TSS) are the suspended organic and inorganic particulate matter in water. Although increasing TSS can also be an indication of increased runoff from land, TSS differs from turbidity in that it is a measure of the mass of material in, rather than light transmittance through, a water sample. High TSS can adversely impact fish and fish food populations and damage invertebrate populations. There are no explicit State standards for TSS.

HEAVY METALS

Concentrations of cadmium, chromium, copper, lead, mercury, and nickel in water are routinely measured by the Department to compare to State standards intended to protect aquatic life and human health. These metals occur naturally in the environment, and many are essential trace elements for plants and animals. Human activities, such as land use changes and industrial and agricultural processes have resulted in an increased flux of metals from land to water. Atmospheric inputs are recognized as important sources of metals to aquatic systems. Metals are released to the atmosphere from the burning of fossil fuels (coal, oil, gasoline), wastes (medical, industrial, municipal), and organic materials. The metals are then deposited on land and in waterways from the atmosphere via rainfall and attached to particulates (dry deposition).

Assessment Methodology

The Watershed Water Quality Assessment is a geographically-based document that describes, at the watershed level, water quality as well as conditions and activities related to water quality. Significant revisions to South Carolina's Water Quality Standards were effective on June 22, 2001. USEPA

approved these standards for use in implementing the Clean Water Act on November 28, 2001. The data assessments for this document were based on previous Water Quality Standards. This section provides an explanation of the information assessment methodology used to generate the watershed-level summaries. Water quality data summaries used in this assessment are presented in Appendices A-C.

USE SUPPORT DETERMINATION

At the majority of SCDHEC's surface water monitoring stations, samples for analysis are collected as surface grabs once per month, quarter, or year, depending on the parameter. Grab samples collected at a depth of 0.3 meters are considered surface measurements, and are used to establish representative physical conditions and chemical concentrations in the waterbodies sampled. At most stations sampled by boat, dissolved oxygen and temperature are sampled as a water column profile, with measurements being made at a depth of 0.3 meters below the water surface and at one-meter intervals to the bottom. At stations sampled from bridges, these parameters are measured only at a depth of 0.3 meters. All water and sediment samples are collected and analyzed according to standard procedures. Macroinvertebrate community structure is analyzed routinely at selected stations as a means of detecting adverse biological impacts on the aquatic fauna due to water quality conditions which may not be readily detectable in the water column chemistry.

For the purpose of assessment, only results from surface samples are used in water quality standards comparisons and trend assessments. This information is considered to represent "average" conditions, as opposed to extremes, because of the inability to target individual high or low flow events on a statewide basis. Results from water quality samples can be compared to State standards and USEPA criteria, with some restrictions due to time of collection and sampling frequency. The monthly sampling frequency employed in the ambient monitoring network may be insufficient for strict interpretation of certain standards. The USEPA does not define the sampling method or frequency other than indicating that it should be "representative." A grab sample is considered to be representative for indicating excursions relative to standards: a single grab sample is more representative of a one-hour average than a four-day average, more representative of a one-day average than a one-month average, and so on (see also Screening & Additional Considerations for Water Column Metals below). When the sampling method or frequency does not agree with the intent of the particular standard, conclusions about water quality should be considered as only an indication of conditions.

The time period used to assess standards compliance is the most recent complete five years of data, which for the Broad River Basin is 1995 through 1999.

AQUATIC LIFE USE SUPPORT

One important goal of the Clean Water Act and State standards is to maintain the quality of surface waters in order to provide for the survival and propagation of a balanced indigenous aquatic community of fauna and flora. The degree to which aquatic life is protected (aquatic life use support) is assessed by comparing important water quality characteristics and the concentrations of potentially toxic pollutants with standards. Aquatic life use support is based on the percentage of standards excursions at a sampling site, and where data are available, the composition and functional integrity of the biological

community. For lakes, support of aquatic life uses is also evaluated using a measure of trophic state. A number of waterbodies have been given specific standards for pH and dissolved oxygen, which reflect natural conditions.

For assessment purposes, a dissolved oxygen (DO) standard of not less than 4 mg/l is used for Class SB, a standard of not less than 6 mg/l is used for TN and TPGT, and a daily average not less than 5 mg/l with a low of 4 mg/l is used for all other Classes. The term excursion is used to describe a DO concentration measurement of less than the stated standard. Dissolved oxygen and pH may vary from the ranges specified in the standards due to a variety of natural causes.

For pH, there are several acceptable ranges applied depending on the Class of water: 6-8 SU for TPGT; 6-8.5 SU for FW; 5-8.5 SU for FW*; and 6.5-8.5 for SFH, SA, and SB. For DO and pH, if 10 percent or less of the samples contravene the appropriate standard, then aquatic life uses are said to be fully supported. A percentage of standards excursions between 11-25 is considered partial support, and a percentage greater than 25 is considered to represent nonsupport, unless excursions are due to natural conditions.

When comparing sampling data to DO standards, it is necessary to consider sampling bias due to season or tide stage. Samples are collected as a single instantaneous grab sample, which is not truly representative of the daily average used as the criterion for most classifications. Secondary stations are sampled only during summer months and generally experience a higher percentage of DO excursions as a result. It is essential to examine the data to ascertain such patterns of excursions before summarily concluding that the indicated violations constitute poor water quality.

For any individual toxicant (heavy metals, priority pollutants, chlorine, ammonia), if the acute aquatic life standard is exceeded in more than 10 percent of the samples, based on at least ten samples, aquatic life uses are not supported. If the acute aquatic life standard is exceeded more than once, but in less than or equal to 10 percent of the samples, uses are partially supported. If fewer than ten samples were collected, discretion must be used and other factors considered, such as the magnitude of the excursions or number of toxicants with excursions. In such a circumstance, the site is prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation. Biological data are the ultimate deciding factor for determining support of aquatic life uses, regardless of chemical conditions.

MACROINVERTEBRATE DATA INTERPRETATION

Macroinvertebrate community assessments are used, where available, to supplement or verify Aquatic Life Use Support determinations and to evaluate potential impacts from the presence of sediment contaminants. Aquatic and semi-aquatic macroinvertebrates are identified to the lowest practical taxonomic level depending on the condition and maturity of specimens collected. The EPT Index and the North Carolina Biotic Index are the main indices used in analyzing macroinvertebrate data. To a lesser extent, taxa richness and total abundance may be used to help interpret data.

The EPT Index or the Ephemeroptera (mayflies) - Plecoptera (stoneflies) - Trichoptera (caddisflies) Index is the total taxa richness of these three generally pollution-sensitive orders. EPT values are compared with least impacted regional sites. The Biotic Index for a sample is the average

pollution tolerance of all organisms collected, based on assigned taxonomic tolerance values. A database is currently being developed to establish significant EPT index levels to be used in conjunction with the Biotic Index to address aquatic life use support.

Taxa richness is the number of distinct taxa collected and is the simplest measure of diversity. High taxa richness is generally associated with high water quality. Increasing levels of pollution progressively eliminate the more sensitive taxa, resulting in lower taxa richness. Total abundance is the enumeration of all macroinvertebrates collected at a sampling location. This is generally not regarded as a qualitative metric. However, when gross differences in abundance occur between stations this metric may be considered as a potential indicator.

RECREATIONAL USE SUPPORT

The degree to which the swimmable goal of the Clean Water Act is attained (recreational use support) is based on the frequency of fecal coliform bacteria excursions, defined as greater than 400/100 ml for all surface water classes. Comparisons to the bacteria geometric mean standard are not considered appropriate based on sampling frequency and the intent of the standard. If 10 percent or less of the samples are greater than 400/100 ml then recreational uses are said to be fully supported. A percentage of standards excursions between 11-25 percent is considered partial support of recreational uses, and greater than 25 percent is considered to represent nonsupport of recreational uses.

FISH CONSUMPTION USE SUPPORT

The Department uses a risk-based approach to evaluate fish tissue data and to issue consumption advisories in affected waterbodies. This approach contrasts the average daily exposure dose to the reference dose (RfD). Using these relationships, fish tissue data are interpreted by determining the consumption rates that would not be likely to pose a health threat to adult males and nonpregnant adult females. Because an acceptable RfD for developmental neurotoxicity has not been developed, pregnant women, infants, and children are advised to avoid consumption of fish from any waterbody where a mercury advisory was issued.

Fish consumption use support is determined by the occurrence of advisories or bans on consumption for a waterbody. For the support of fish consumption uses, a fish consumption advisory indicates partial use support, a consumption ban indicates nonsupport of uses.

HUMAN HEALTH STANDARDS

State standards for human health are also evaluated in the preparation of the Watershed Water Quality Assessments. For contaminants with human health standards (e.g. heavy metals, pesticides), a potential human health threat is indicated if the median concentration exceeds the standard.

Additional Screening and Prioritization Tools

Evaluation of water quality data and other supplemental information facilitates watershed planning. Information from the following sources is used to develop watershed-based protection and prevention strategies.

LONG-TERM TREND ASSESSMENT

As part of the Watershed Water Quality Assessments, surface data from each station are analyzed for statistically significant long-term trends using a modification of Kendall's tau, which is a nonparametric test removing seasonal effects. Flows are not available for most stations, and the parametric concentrations are not flow-corrected. Seasonal Kendall's tau analysis is used to test for the presence of a statistically significant trend of a parameter, either increasing or decreasing, over a fifteen-year period. It indicates whether the concentration of a given parameter is exhibiting consistent change in one direction over the specified time period. A two sided test at $p=0.1$ is used to determine statistically significant trends, and the direction of trend. An estimate of the magnitude of any statistically significant trend is calculated.

A rigorous evaluation for trends in time-series data usually includes a test for autocorrelation. The data are not tested for autocorrelation prior to the trend analysis. It is felt that autocorrelation would not seriously compromise a general characterization of water quality trends based on such a long series of deseasonalized monthly samples.

One of the advantages of the seasonal Kendall test is that values reported as being below detection limits (DL) are valid data points in this nonparametric procedure, since they are all considered to be tied at the DL value. When the DL changed during the period of interest, all values are considered to be tied at the highest DL occurring during that period. Since it is possible to measure concentrations equal to the value of the DL, values less than DL are reduced by subtraction of a constant so that they remain tied with each other, but are less than the values equal to the DL. Since fecal coliform bacteria detection limits vary with sample dilution, there is no set DL; therefore, for values reported as less than some number, the value of the number is used.

For the purposes of this assessment, long-term trends in selected parameters were examined using data collected from 1984 through 1999. In 1992 a phosphate detergent ban was instituted in South Carolina, so for total phosphorus a second trend assessment is included for the period 1992 through 1999. For total phosphorus it is this second time period that is reported in the text.

SEDIMENT SCREENING

There are no sediment standards; therefore, in order to identify sediments with elevated metals concentrations, percentiles are constructed using five years of statewide sediment data. Only values greater than the detection limit were used for chromium, copper, nickel, lead, and zinc. Because so few concentrations of cadmium and mercury are measured above the detection limit, all samples were pooled for these metals. A sediment metal concentration is considered to be high if it is in the top 10% of the pooled results, and very high if it is in the top 5%. Any analytical result above detection limits is flagged for pesticides, PCBs, and other priority pollutants. Sites with noted high metals concentrations or the occurrence of other contaminants above detection limits are prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation.

For saltwater sediments, national studies have been conducted by the National Oceanic and Atmospheric Administration (NOAA) and the State of Florida that have developed Sediment Quality

Guidelines (SQGs) for the United States and the southeastern region. These SQGs summarize all published toxicology and biomonitoring studies for a given contaminant and ranked them from lowest to highest concentration where an adverse effect was observed. The tenth percentile of the ranked data, from all published studies that reported an adverse effect, is termed the Effects Range Low (ERL) or Threshold Effects Level (TEL) and represents the threshold concentration for toxicity to occur. The median concentration where adverse effects in benthos are observed (the fiftieth percentile) is termed the Effects Range Median (ERM) or Probable Effects Levels (PEL). Measured sediment contaminant levels may be compared with ERLs/ERMs or TELs/PELs to predict potential probability for sediment bound contaminants to cause toxicity in benthic faunal communities. Saltwater sediment contaminant levels were compared with existing sediment quality guidelines by both individual compound. Sites with sediments which had individual chemical contaminant concentrations which exceeded ERL/TEL and ERM/PEL guideline levels are identified to indicate that trace metal, pesticide, PAH or PCB concentrations exceeded levels potentially toxic to estuarine organisms.

WATER COLUMN METALS ANALYSES

The USEPA criteria for heavy metals to protect aquatic life are specified as a four-day average and a one-hour average, and have been adopted as State standards. Because of the quarterly sampling frequency for heavy metals, comparisons to chronic toxicity standards (four-day average concentration) are not considered appropriate; therefore, only the acute standard (one-hour average) for the protection of aquatic life is used in the water quality assessment (Table 1).

Table 1. Metal Standards in Water (µg/l)

Metal	Present Detection Level	Freshwater 1Hr. Acute Ave.	Saltwater 1Hr. Acute Ave.	Human Health
*Cadmium	10.0	1.79	43.0	5.00
Chromium (VI)	10.0	16.00	1100.0	100.00
*Copper	10.0	9.22	2.9	
*Lead	50.0	33.78	140.0	
Mercury	0.2	2.40	2.1	0.15
*Nickel	20.0	789.00	75.0	100.00
*Zinc	10.0	65.00	95.0	5000.00

* Freshwater standards based on a hardness of 50 mg/l as $CaCO_3$.

Zinc and copper are elevated in surface waters statewide and concentrations are frequently measured in excess of the calculated acute aquatic life standards. To identify areas where zinc, copper, and other metals are elevated in the water column above normal background concentrations, concentrations greater than the detection limit from all SCDHEC monitoring sites statewide for a five-

year period are pooled and the 90th and 95th percentiles are computed. This is done separately for each metal for both fresh and saltwaters. The individual measurements from each monitoring station are then compared to these percentiles, as well as to State standards. As in sediments, a metal concentration is referred to as "high" if it is in the top 10% of the pooled results, and "very high" if it is in the top 5%. All water column values referred to as "high" or "very high" are also in excess of the acute aquatic life standard listed in Table 1. For chromium, because so few concentrations are above the detection limit, all samples collected are used to generate the percentiles. Sites with high metals concentrations are prioritized for the collection of biological data, or additional monitoring and investigation, to verify the true situation.

The analytical procedures used by the Department yield total metal concentration, which is a relatively conservative measure, since the total metal concentration is always greater than the acid-soluble or dissolved fraction. Most heavy metal criteria for freshwater are calculated from formulas using water hardness. The formulas used to calculate criteria values are constructed to apply to the entire United States, including Alaska and Hawaii. As with all the USEPA criteria, there is also a large margin of safety built into the calculations. The applicability of the hardness-based criteria derived from the USEPA formulas to South Carolina waters has been a subject of much discussion. Hardness values vary greatly nationwide (from zero into the hundreds), with South Carolina representing the lower end of the range (statewide average value is approximately 20 mg/l). Representatives of the USEPA Region IV standards group have stated that no toxicity data for hardness values less than 50 mg/l were used in the development of the formulas. They have expressed reservations about the validity of the formulas when applied to hardness values below 50 mg/l. Based on this opinion, South Carolina's State standards for metals are based on a hardness of 50 mg/l for waters where hardness is 50 mg/l or less, resulting in several criteria values below the Department's current analytical detection limits. Therefore, any detectable concentration of cadmium, copper, or lead is an excursion beyond recommended criteria.

The SCDHEC monitoring data have historically indicated that zinc and copper levels in South Carolina waters are elevated relative to USEPA criteria, apparently a statewide phenomenon in both fresh and salt waters, and possibly resulting from natural conditions, nonpoint sources, or airborne deposition. These levels do not appear to adversely affect state fisheries or macroinvertebrate communities, which suggests that the levels are the result of long-term local conditions to which the fauna have adapted, as opposed to point source pollution events. It is difficult to assess the significance of heavy metal excursions due to the questionable applicability of the formulas at low hardness values and calculated criteria below present detection limits.

NPDES Program

The Water Facilities Permitting Division and the Industrial, Agricultural, and Stormwater Permitting Division are responsible for drafting and issuing National Pollutant Discharge Elimination System (NPDES) permits. Facilities are defined as either "major" or "minor". For municipal permits, a facility is considered a "major" if it has a permitted flow of 1 MGD or more and is not a private facility. The determination for industrial facilities is based on facility and stream characteristics, including

toxicity, amount of flow, load of oxygen, proximity of drinking water source, potential to exceed stream standards, and potential effect on coastal waters.

Permitting Process

A completed draft permit is sent to the permittee, the SCDHEC District office, and if it is a major permit, to the USEPA for review. A public notice is issued when the permit draft is finalized. Comments from the public are considered and, if justified, a public hearing is arranged. Both oral and written comments are collected at the hearing, and after considering all information, the Department staff makes the decision whether to issue the permit as drafted, issue a modified permit, or to deny the permit. Everyone who participated in the process receives a notice of the final decision. A copy of the final permit will be sent to anyone who requests it. Staff decisions may be appealed according to the procedures in R.61-72 and the rule of the Administrative Law Judge Division of South Carolina.

The permitting Divisions use general permits with statewide coverage for certain categories of discharges. Discharges covered under general permits include utility water, potable surface water treatment plants, potable groundwater treatment plants with iron removal, petroleum contaminated groundwater, mine dewatering activities, aquaculture facilities, bulk oil and gas terminals, hydrostatic test waters (oil & gas lines), and vehicle wash waters. Additional activities proposed for general permits include ready-mix concrete/concrete products and concentrated animal feeding operations. State Land application systems for land disposal and lagoons are also permitted.

Wasteload Allocation Process

A wasteload allocation (WLA) is the portion of a stream's assimilative capacity for a particular pollutant that is allocated to an existing or proposed point source discharge. Existing WLAs are updated during the basin review process and included in permits during the normal permit expiration and reissuance process. New WLAs are developed for proposed projects seeking a discharge permit or for existing discharges proposing to increase their effluent loading at the time of application. Wasteload allocations for oxygen demanding parameters and nutrients are developed by the Water Quality Modeling Section, and WLAs for toxic pollutants and metals are developed by the appropriate permitting division.

The ability of a stream to assimilate a particular pollutant is directly related to its physical and chemical characteristics. Various techniques are used to estimate this capacity. Simple mass balance/dilution calculations may be used for a particular conservative (nondecaying) pollutant while complex models may be used to determine the fate of nonconservative pollutants that degrade in the environment. Waste characteristics, available dilution, and the number of discharges in an area may, along with existing water quality, dictate the use of a simple or complex method of analysis. Projects that generally do not require complex modeling include: groundwater remediation, noncontact cooling water, mine dewatering, air washers, and filter backwash.

Streams are designated either effluent limited or water quality limited based on the level of treatment required of the dischargers to that particular portion of the stream. In cases where the USEPA published effluent guidelines and the minimum treatment levels required by law are sufficient to maintain instream water quality standards, the stream is said to be effluent limited. Streams lacking the

assimilative capacity for a discharge at minimum treatment levels are said to be water quality limited. In cases where better than technology limits are required, water quality, not minimum requirements, controls the permit limits. The Department's Water Quality Modeling Section recommends limits for numerous parameters including ammonia nitrogen (NH3-N), dissolved oxygen (DO), total residual chlorine (TRC), and five-day biochemical oxygen demand (BOD5). Limits for other parameters, including metals, toxics, and nutrients are developed by the Water Facilities Permitting Division or the Industrial, Agricultural, and Stormwater Permitting Division in conjunction with support groups within the Department.

Nonpoint Source (NPS) Management Program

NPS water pollution, sometimes called Arunoff pollution@ or Apolluted runoff@ does not result from a discharge at a specific, single location (or point), but generally comes from diffuse, numerous sources. Runoff occurring after a rain event may transport sediment from plowed fields, construction sites, or logging operations, pesticides and fertilizers from farms and lawns, motor oil and grease deposited on roads and parking lots, or bacteria containing waste from agricultural animal facilities or malfunctioning septic systems. The rain moves the pollutants across the land to the nearest waterbody or storm drain where they may impact the water quality in creeks, rivers, lakes, estuaries, and wetlands. NPS pollution may also impact groundwater when it is allowed to seep or percolate into aquifers. Adverse effects of NPS pollution include physical destruction of aquatic habitat, fish kills, interference with or elimination of recreational uses of a waterbody (particularly lakes), closure of shellfish beds, reduced water supply or taste and odor problems in drinking water, and increased potential for flooding because waterbodies become choked with sediment.

Congress recognized the growing problem of nonpoint source pollution in the late 1980s, and added NPS provisions to the federal law. Section 319 of the 1987 Amendments to the Clean Water Act required states to assess the nonpoint source water pollution associated with surface and groundwater within their borders and then develop and implement a management strategy to control and abate the pollution. The first Assessment of Nonpoint Source Pollution in South Carolina accomplished this purpose. The Department=s Bureau of Water manages the ongoing State NPS Management Program, which develops strategies and targets waterbodies for priority implementation of management projects. Section 319 funds various voluntary efforts, including watershed projects, which address many aspects of the pollution prevention management measure and provide education, outreach and technical assistance to various groups and agencies. Most of the projects are implemented by cooperating agencies.

Many land activities can individually or cumulatively contribute to NPS pollution. Eight categories of NPS pollution sources have been identified as contributing to water quality degradation in South Carolina: agriculture, forestry, urban areas, marinas and recreational boating, mining, hydrologic modification, wetlands and riparian areas disturbance, land disposal, and groundwater contamination. There are programs, both regulatory and voluntary, in-place that address all eight categories.

Agriculture

In South Carolina, pesticides, fertilizers, animal waste, and sediment are potential sources of agricultural NPS pollution. Agricultural activities also have the potential to directly impact the habitat of

aquatic species through physical disturbances caused by livestock or equipment, and through the management of water. The State has laws and regulations that prevent NPS pollution from several agricultural sources including pesticides and animal waste. Funding programs including those under section 319 grants from EPA, cost share funds from USDA under EQIP and CRP are used to implement best management practices that are not covered under regulations. Agriculture land acreage is quantified in the basin-wide and individual watershed evaluations.

Silviculture

Forests comprise a major portion of South Carolina=s land base. Sixty-six percent, or 12.6 million acres, of the State=s total land area is in timberland. Silvicultural practices associated with road access, harvest, and regeneration of timber present the most significant potential for NPS pollution. Silvicultural activities have the potential to degrade the State=s waters through the addition of sediment, nutrients, organics, elevated temperature, and pesticides. Erosion and subsequent sedimentation are the most significant and widespread NPS problems associated with forestry practices. Sudden removal of large quantities of vegetation through harvesting or silvicultural practices can also increase leaching of nutrients from the soil system into surface waters and groundwaters. Programs to abate or control NPS pollution from forestry activities are primarily the responsibility of the S.C. Forestry Commission (SCFC) and the United States Department of Agriculture=s Forest Service (USFS), with other agencies having supplementary programs. S.C. Forestry Commission provides monthly courtesy exams to SCDHEC's Division of Water Quality and to forest industries. If water quality was impacted by a forestry operation, SCDHEC may institute enforcement action under the South Carolina Pollution Control Act. The United States Department of Agriculture=s Natural Resources Conservation Service (USDA-NRCS) also provides technical assistance to government, landowners, and land users. Forest land acreage is quantified in the basin-wide and individual watershed evaluations.

Urban Areas

Urbanization has been linked to the degradation of urban waterways. The major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction sites are a major source of sediment erosion. Nutrient and bacterial sources of contamination include fertilizer usage, pet wastes, leaves, grass clippings, and faulty septic tanks. Petroleum hydrocarbons result mostly from automobile sources. In the 1980's, the average statewide population growth was 11.7 percent, while the coastal counties had an increase of 22 percent, nearly double the State rate during the same time period. This continuing development and population growth has the potential to make urban runoff the most significant source of pollution in waters of the State in the future. Urban land acreage is quantified in the basin-wide and individual watershed evaluations.

SCDHEC has a number of statewide programs that address components of urban NPS pollution. The Bureau of Water (BOW) administers four permitting programs that control runoff from new and existing urban sources. These include the Stormwater and Sediment Reduction program, Municipal

Separate Storm Sewer System (MS4), Industrial NPDES Stormwater Permits, and the Section 401 water quality certification program (see p.24). Additional controls for urban runoff in the coastal zone are implemented by SCDHEC's Oceans and Coastal Resources Management (OCRM) through the State Coastal Zone Management Plan.

The Bureau of Environmental Health=s Division of Onsite Wastewater Management administers the Onsite Sewage Disposal System program for the entire State, and oversees the permitting for the installation and management of septic systems. Although not associated with urban land use, this Division permits the septic systems of camping facilities if the facility is not on public sewer. The types of camping facilities that fall into this category through R.61-39 are Resident Camps and Family Camps. Resident camps are organized camps where one or more buildings are provided for sleeping quarters. These camps are typically operated for educational, recreational, religious, or health purposes. Family camps are organized camps where campsites are provided for use by the general public or certain groups. The camp sewage is discharged into a public collection, treatment and disposal system if available, or an onsite wastewater treatment and disposal system (septic tank) is used. Camp locations are identified in the appropriate watershed evaluations.

Marinas and Recreational Boating

Potential adverse environmental impacts associated with marinas include dissolved oxygen deficiencies and high concentrations of toxic metals in aquatic organisms. In addition, marina construction activities can lead to the physical destruction of sensitive ecosystems and bottom-dwelling aquatic communities. Presently, there are more than 100 marinas in South Carolina, with 68 of them in the coastal zone. The U.S. Army Corps of Engineers and the SCDHEC are responsible for permitting marinas in South Carolina. Within SCDHEC, the two offices that have marina permitting authority are the Office of Ocean and Coastal Resource Management (SCDHEC OCRM) and the Office of Environmental Quality Control (SCDHEC Bureau of Water). SCDHEC OCRM issues critical area permits for marinas within the critical area of the coastal zone. SCDHEC Bureau of Water issues permits for marinas at all other locations within the State and issues Section 401 Water Quality Certifications (see p.24) for marinas statewide. The U.S. Coast Guard and the S.C. Department of Natural Resources are responsible for managing recreational boating activity.

Mining

South Carolina's mineral production consists of non-fuel minerals that provide raw materials for construction products and a precious metal industry. Portland cement clays (kaolin and brick), sand and gravel, and crushed stone represent the majority of the total mineral value. At the end of FY 1997-1998, there were 495 mining operations in South Carolina affecting more than 19,000 acres. Surface mining has the potential to generate NPS pollution during mineral exploration, mine development extraction, transportation, mining and processing, product storage, waste disposal, or reclamation. Potential nonpoint source impacts related to mining activities generally include hydrologic modification, erosion and sedimentation, water quality deterioration, fish and wildlife disturbances, and public nuisances.

The Department=s Bureau of Land and Waste Management has primary regulatory responsibility for mining activities. Within the Bureau, the Division of Mining and Solid Waste Permitting is responsible for administering and implementing the S.C. Mining Act and its associated regulations. The Mining Act serves as part of an overall management plan for NPS pollution from active mines. Mining activities and locations are identified in the appropriate watershed evaluations.

Hydromodification

Hydrologic modification (or hydromodification) is defined as stream channelization, channel modification, and dam construction. These activities can negatively impact water quality, destroy or modify in-stream habitat and increase streambank and shoreline erosion. Two State permits, implemented by the SCDHEC, are involved in the implementation of management measures for hydromodification. A critical area permit is required for coastal waters, saltwater wetlands, and beaches defined as critical areas. A navigable waters permit is required for the remainder of the State. Implementation of State policy for dam construction is similar to control of other hydromodification projects in South Carolina, requiring the same State permits and certifications. In addition, dams require a State dam safety permit or a State stormwater management and sediment reduction permit. The Department must also issue Water Quality Certifications pursuant to Section 401 of the Federal Clean Water Act for dam construction and hydropower operations licensed by the Federal Energy Regulatory Commission.

Wetlands

Twenty-three percent of South Carolina is covered by 4.5 million acres of wetlands. The U.S. Army Corps of Engineers implements the federal program for regulating development in wetlands with guidelines established by EPA. The Corps delineates wetlands and determines which wetlands fall under regulatory jurisdiction and require a federal permit for development. The Wetlands Reserve Program, administered by the NRCS, is designed to restore and protect wetlands. At the state level, the primary focus of wetland regulation is the '401 Water Quality Certification. In the '401 certification process, applications for wetland alterations may be denied or modified due to the special nature of a wetland or the functions that a wetland provides. Wetland impacts must be compensated through restoration, enhancement, preservation, or creation and protected in perpetuity. Future development would be prohibited in these mitigated and legally protected areas. Knowledge of areas that are restricted from development due to mitigation or special water classification is useful in planning future development in a watershed. Wetland acreage is quantified in the basin-wide and individual watershed evaluations.

Land Disposal

Although modern solid waste disposal sites are considered point sources of pollution and regulated, leachate from sanitary landfills and dumps have the potential to pollute large portions of adjacent groundwater aquifers. Toxic compounds are commonly a part of the overall composition of landfill leachate, especially when the landfill has been used for the disposal of toxic chemicals. There are currently 140 permitted landfills in South Carolina. This total represents 35 municipal solid waste landfills (MSWLF), 62 industrial waste landfills, 41 construction and demolition (C&D) landfills, one

sludge monofill, and one ash monofill. Regulatory authority over solid waste disposal activities resides with SCDHEC's Bureau of Land and Waste Management. All active and closed industrial and municipal solid waste landfills are identified in the appropriate watershed evaluations.

Land application is a form of recycling because it allows recovery of elements needed for crop production. Land application of biosolids may be beneficial and environmentally sound when applied at the correct agronomic rate. Land applying biosolids can benefit farmers by offsetting the costs of fertilizer and lime while reducing the pressure on existing landfills. SCDHEC=s Bureau of Water, Division of Water Monitoring, Assessment and Protection, Groundwater Quality Section conducts a program to prevent, monitor, and correct groundwater contamination from nonpoint source pollution from land application of wastewater biosolids, solids, animal manures, biosolids, and sewage sludge. Land application, which is not a discharge, requires a "no discharge" permit (ND). All active industrial and municipal land applications are identified in the appropriate watershed evaluations.

Groundwater Contamination

All aquifers in the State are potential Underground Sources of Drinking Water and are protected under the S.C. Water Classifications and Standards. Groundwaters are thus protected in a manner consistent with the SCDHEC groundwater protection strategy. Staff hydrogeologists implement a screening program for nonpoint source impacts from pits, ponds, and lagoons associated with the permitted storage, treatment, and disposal of industrial and municipal wastewaters. In cases where a groundwater impact has been identified in violation of S.C. Water Classifications and Standards, appropriate actions will be coordinated with the facility owner to ensure regulatory compliance. The hydrogeologist coordinates with the facility owner to implement source identification, contaminant extent assessments, initiation of contaminant remediation systems, and performance evaluations of corrective actions. In addition to releases from wastewater treatment systems, the staff evaluates releases from other nonpoint sources such as above ground tanks, nonregulated fuel oil tanks, spills and/or leaks. Sites with confirmed groundwater impact will be placed under a Consent Agreement or an Order. SCDHEC=s South Carolina Groundwater Contamination Inventory quantifies the status of groundwater quality in South Carolina. The sites in the inventory are known groundwater contamination cases in the State, and are referenced by name and county, and updated annually.

Water Supply

Water treatment facilities are permitted by the Department for municipal and industrial potable water production. As per the 1983 Water Use Reporting and Coordination Act (Act 282), all water uses over 100,000 gallons per day must report their usage. This includes industrial, agricultural, mining, golf courses, public supply, commercial, recreational, hydropower, thermo power, and nuclear power activities. Intake location and the volume removed from a stream are identified in the watershed evaluations for municipal (potable) uses.

Consumer Confidence Reports

The Consumer Confidence Report (CCR) is an annual water quality report required of all Community water systems. The rationale behind the CCR is that consumers have a right to know what is in their drinking water and where it comes from. These reports are to educate consumers and help them make informed choices that affect the health of themselves and their families. It is believed that educated consumers are more likely to protect their drinking water sources. All CCRs are to include the following basic components:

- the water source, its location, and the availability of source water assessment plan;
- information about the water system (name and telephone number of a contact person, opportunities for public participation, and information for non-English speaking populations if applicable);
- definitions of terms and abbreviations used in the report;
- table of detected contaminants including the known or likely source of the contaminants;
- the health effects language for Maximum Contaminant Level violations and an explanation of the violation;
- information on cryptosporidium, radon, and other contaminants if applicable; and
- educational information that includes an explanation of contaminants and their presence in drinking water, an advisory for immuno-compromised people, the Safe Drinking Water Hotline telephone number, and other statements about lead, arsenic, and nitrate if applicable.

Growth Potential and Planning

Land use and management can define the impacts to water quality in relation to point and nonpoint sources. Assessing the potential for an area to expand and grow allows for water quality planning to occur and, if appropriate, increased monitoring for potential impairment of water quality. Indicators used to predict growth potential include water and sewer service, road and highway accessibility, and population trends. These indicators and others were used as tools to determine areas within the Broad River Basin having the greatest potential for impacts to water quality as a result of development.

SCDHEC's Strategic Plan for 2000-2005 (www.scdhec.net/news/releases/pdf files/Stratpln.pdf) acknowledges that growth issues are best handled at the local government level. SCDHEC's role is to work with local governments and communities to help them understand the importance of planning for smart growth: buffers, greenspaces, mass transit, subdivision and roadway planning, bike paths and bike lanes, and park and ride lots. SCDHEC can also provide assistance in helping local entities access information and provide consultation on technical issues such as the establishment of buffers and watershed stormwater planning. Many counties in the Broad River Basin lack county wide zoning ordinances; therefore, there is little local regulatory power to influence the direction or magnitude of regional growth. The majority of municipalities have zoning ordinances in place; however, much of the growth takes place just outside the municipal boundaries, where infrastructure is inadequate. Section 208 of the Clean Water Act serves to encourage and facilitate the development and implementation of areawide waste treatment management plans. The '208 Areawide Water Quality Management Plans were completed in great detail during the 1970's and have recently been updated. Information from the updated reports is used in the individual watershed evaluations. South Carolina's water quality management plans support consolidation of wastewater treatment facilities into larger regional systems.

Watershed boundaries extend along topographic ridges and drain surrounding surface waters. Roads are commonly built along ridge tops with the best drainage conditions. Cities often develop in proximity to ridges as a result of their plateau terrain. It is not uncommon, then, to find cities or road corridors located along watershed boundaries, and thus influencing or impacting several watersheds.

Watershed Protection and Restoration Strategies

SCDHEC's Bureau of Water is responsible for ensuring that South Carolina's water is safe for drinking and recreation, and suitable to support aquatic life. This section provides an overview of other important Bureau programs and strategies applied statewide to protect and restore water quality. The point and nonpoint source controls described previously assist with achieving these goals.

Under section 303(d) of the Federal Clean Water Act, each state is required to provide a comprehensive inventory of impaired waters for which existing required pollution controls are not stringent enough to achieve State water quality standards or Federal Clean Water Act goals. This biennial list, commonly referred to as the "303(d) list", is the basis for targeting waterbodies for watershed-based solutions. A copy of the current 303(d) list can be obtained by contacting the Bureau of Water. Several Bureau programs address these impaired streams in an effort to restore them.

Total Maximum Daily Load

A Total Maximum Daily Load (TMDL) is the calculated maximum allowable pollutant loading to a waterbody at which water quality standards are maintained. A TMDL is made up of two main components, a load allocation and a wasteload allocation. A load allocation is the portion of the receiving water's loading capacity attributed to existing or future nonpoint sources or to natural background sources. The waste load allocation is the portion of a receiving water's loading capacity allocated to an existing or future point source.

A TMDL is a means for recommending controls needed to meet water quality standards in a particular water or watershed. Historically, the typical TMDL has been developed as a wasteload allocation, considering a particular waterbody segment, for a particular point source, to support setting effluent limitations. In order to address the combined cumulative impacts of all sources, broad watershed-based TMDLs are now being developed.

The TMDL process is linked to all other State water quality activities. Water quality impairments are identified through monitoring and assessment. Watershed-based investigations result in source identification and TMDL development. TMDLs form links between water quality standards and point and nonpoint source controls. Where TMDLs are established, they constitute the basis for NPDES permits and for strategies to reduce nonpoint source pollution. The effectiveness and adequacy of applied controls are evaluated through continued monitoring and assessment.

Funding for TMDL implementation is currently available with USEPA’s Section 319 of the Clean Water Act grants. For more information, see the Bureau of Water web page www.scdhec.net/water or call the Watershed Program at (803) 898-4300.

Antidegradation Implementation

The State's Antidegradation Policy as part of S.C. Regulation 61-68 is represented by a three-tiered approach to maintaining and protecting various levels of water quality and uses; streams included on the 303(d) list are addressed under Tier 1. Tier 1 antidegradation policies apply to all waters of the

State and require that existing uses and the minimum level of water quality for those uses be maintained and protected. Tier 2 policies apply to high quality water where the water quality exceeds the mandatory minimum levels to support the Clean Water Act's goals of propagation of fish, shellfish, wildlife, and recreation in and on the water. The Department considers all the waters of the State as high quality waters. Tier 3 policies apply to the maintenance of water quality in waters that constitute an Outstanding National Resource Water and do not allow for any permanent permitted dischargers. Outstanding Resource Waters of the State are provided a higher level of protection than Tier 2, but do not meet the requirements of Tier 3.

Tier 1 protection will be implemented when applying numeric standards included in Regulation 61-68 for human health, aquatic life, and organoleptic protection as follows: if a waterbody has been affected by a parameter of concern causing it to be on the 303(d) list, then the Department will not allow a permitted net increase of loading for the parameter of concern unless the concentration will not contribute to a violation of water quality standards. This no net increase will be achieved by reallocation of existing total load(s) or by meeting applicable water quality standard(s) at the end-of-pipe. No discharge will be allowed to cause or contribute to further degradation of a 303(d) listed waterbody.

The Antidegradation Rules apply to both nonpoint source pollution and for point sources into impaired waters. Many activities contributing to nonpoint source pollution are controlled with voluntary measures. The Department implements permitting or certification programs for some of these activities and has the opportunity to ensure compliance with the Antidegradation Rules. The activities of primary concern are land development projects which are immediately adjacent to and discharge runoff or stormwater into impaired waters.

401 Water Quality Certification Program

If a Federal permit for a discharge into waters of the State, including wetlands, is required, the Department must issue Water Quality Certification pursuant to Section 401 of the Federal Clean Water Act. Certification is required for permits issued by the U.S. Army Corps of Engineers for construction in navigable waters and for deposition of dredged or fill material.

Regulation 61-101 presents administrative and technical guidance for the water quality certification program and requires SCDHEC to consider whether or not a project is water dependent; whether or not there are feasible alternatives which will have less adverse consequences on water quality and classified uses; the intended purpose of the project; and all potential water quality impacts of the project, both direct and indirect, over the life of the project. Any project with the potential to affect waters of the State must be conducted in such a manner to maintain the specified standards and classified and existing water uses.

As a routine part of the 401 Water Quality Certification review process, the waterbody in question is identified as impaired or not impaired according to the 303(d) list. If it is impaired, the parameter of concern is noted, along with any steps required to prevent further degradation of the water quality of that waterbody. In an effort to facilitate watershed restoration where appropriate, mitigation for unavoidable wetland impacts is encouraged in areas that improve 303(d) listed waters.

Stormwater Program

Stormwater discharges result from precipitation during rain events. Runoff washes pollutants associated with industrial activities (including construction activity), agricultural operations, and commercial and household sites directly into streams, or indirectly into drainage systems that eventually drain into streams. The SCDHEC Stormwater Permitting Program focuses on pollution prevention to reduce or eliminate stormwater pollution. The Department has general permitting authority for stormwater discharges associated with industrial activity, including construction. General permits SCR000000 and SCR100000 for industrial and construction activities, respectively, require permittees to develop and implement stormwater pollution prevention plans that establish best management practices to effectively reduce or eliminate the discharge of pollutants via stormwater runoff. The Stormwater and Agricultural Permitting Section is responsible for issuing NPDES stormwater permits to prevent degradation of water quality as well as for issuing sediment and erosion control permits for construction sites. Currently, NPDES permits are required for construction sites greater than five acres. SCDHEC's Office of Ocean and Coastal Resource Management manages the State sediment and erosion control in the coastal area.

Regulation 61-9 requires a compilation of all existing State water quality data with STORET data being used as a baseline. If analysis indicates a decrease in water quality then corrective measures must be taken. The permittee will identify all impaired water bodies in a Stormwater Management Plan (SWMP). In addition, existing pollution discharge control methods will be identified and incorporated into the SWMP. Procedures, processes, and methods to control the discharge of pollutants from the municipal separate storm sewer system (MS4) into impaired waterbodies and publicly owned lakes included on the 303(d) list will be described in the SWMP. The effectiveness of these controls will be assessed and necessary corrective measures, if any, shall be developed and implemented.

Permits for municipal systems allow communities to design stormwater management programs that are suited for controlling pollutants in their jurisdiction. There are two population-based categories of municipal separate storms sewers: large municipal (population greater than 250,000) and medium municipal (population between 100,000 and 250,000). In the Broad River Basin, Greenville and Richland Counties and the City of Columbia must obtain a comprehensive municipal permit that addresses stormwater within their jurisdiction. These municipalities are defined as medium municipalities.

South Carolina Animal Feeding Operations Strategy

Among the general categories of pollution sources, agriculture ranks as the number one cause of stream and lake impairment nationwide. Many diseases can potentially be contracted from drinking water or coming into contact with waters contaminated with animal wastes. The Department uses S.C. Regulation 61-43: *Standards for the Permitting of Agricultural Animal Facilities* to address the permitting of animal feeding operations (AFOs). Implementing these regulations and their corresponding compliance efforts are a priority for the Department in order to reduce public health and environmental impacts from AFOs. There are currently no federally defined concentrated animal feeding operations (CAFOs) in operation in South Carolina, and approximately 2,000 AFOs. Using the Watershed Program

cycle and the division of the State into five regions, AFOs will be monitored and inspected by region. The 303(d) list will be used to prioritize the inspections. After all the inspections have been made in a region, the Department will move to the river basins in the next region in the watershed cycle. The Department is continuing to work in cooperation and coordination with the U.S. Department of Agriculture, the Natural Resources Conservation Service, the S.C. Department of Agriculture, the S.C. Soil and Water Conservation Districts, and the Clemson Extension Service.

Sanitary Sewer Overflow Strategy

Sanitary sewers are designed to collect municipal and industrial wastewater, with the allowance for some acceptable level of infiltration and inflow, and transport these flows to a treatment facility. When the sewer system is unable to carry these flows, the system becomes surcharged and an overflow will occur. Sanitary sewer overflows (SSOs) have existed since the introduction of separate sanitary sewers, and most are caused by inadequate operation, maintenance, and management of the collection system.

The Department encourages utilities to embrace the principals of EPA's capacity Management, Operations, and Maintenance (cMOM) program. Through this program utilities can ensure adequate funding and capacity as well as a proactive approach to operations and maintenance. Those that have implemented cMOM programs have been able to significantly reduce or eliminate overflows from their collection systems.

The Department's approach has been to shift resources historically applied to treatment plant inspections to include evaluations of pump stations and collection systems where problems are suspected. To assist evaluators in identifying water quality violations related to SSOs, staff have utilized the 303(d) list of impaired waters to identify waters impacted by fecal coliform or other appropriate pollutants and correlate those with collection systems with incidences of SSOs. The Department's Enforcement Referral Procedures Document is be used to determine when a collection system should be referred to enforcement for SSOs. The enforcement process allows for the Department to consider actions taken by the collection system such as: timely and proper notification, containment and mitigation of discharge, voluntarily conducting self evaluations, and requests for compliance assistance. The Department will take immediate action where it has been determined that SSOs have occurred and the collection system has not made timely and proper notification.

Referral Strategy for Effluent Violations

The Department has developed referral effluent violation guidelines to specifically address discharges into impaired waters. The goal of the referral guidelines is to reduce pollutant discharges into impaired waters in order to ultimately restore them to their full potential usage. To achieve this goal, enforcement actions are initiated earlier in an effort to improve the quality of waters that do not meet standards. If a stream is impaired by a pollutant and the permit limit for that pollutant is exceeded more than once in a running annual reporting period, formal enforcement action will be initiated against the discharger.

SCDHEC=s Watershed Stewardship Programs

Public participation is an important component of the Department's Watershed Water Quality Management Program. Benefits to this interaction on the local level include improved public awareness about SCDHEC water programs, and increased local interest and participation in water quality improvement. Described below are some of the Department's water programs that encourage public interest and involvement in water quality. These programs and their contacts are listed on the Department's website at www.scdhec.net/water.

Source Water Assessment Program

A safe, adequate source of drinking water is key to development of communities and the health of citizens. The Safe Drinking Water Act (SDWA) provides authority to protect sources of drinking water. As a result of the 1996 amendments to the SDWA, source water protection has become a national priority. States are required to develop a plan for assessment of source waters for all federally defined public groundwater and surface water systems.

The Source Water Assessment Program (SWAP) involves determining the boundaries of the areas that are the source of waters for public water systems. For groundwater systems, these areas are defined using groundwater flow models. For surface water systems, the 14-digit Hydrologic Unit Code watershed is the designated protection area (although certain areas within the basin will be segmented as being of greater vulnerability to contamination from overland flow, groundwater contributions to surface water, and direct spills into the surface water). Known and potential sources of contamination in the delineated area must be identified, and the inventoried sources evaluated to determine the susceptibility of public water systems to such contaminants. Assessments must be made available to the public.

Local involvement will be a critical factor in the success of the SWAP, and local government, citizen groups, environmental groups, water suppliers, and the Department must all work together to increase the general public=s awareness of where drinking water comes from and how to better protect sources of drinking water. Implementation of source water protection activities will occur at the local level, and local authorities may wish to base zoning and land-use planning on the source water assessments. The SWAP will be a key part of the Department's watershed management approach. To avoid duplication, information gathered from existing regulatory programs and/or watershed protection efforts will be utilized (e.g., ambient monitoring programs, TMDLs, etc.).

Nonpoint Source Education

The goal of the Nonpoint Source Outreach Program is to educate the citizens of South Carolina about the sources of polluted runoff and techniques that can be used to reduce this runoff. The Program provides presentations on runoff pollution to community, church, civic, or professional groups; a variety of technical and nontechnical publications on runoff pollution and reduction techniques; *Turning the Tide*, a free, quarterly Nonpoint Source newsletter; and teacher training that includes the *Action for a Cleaner Tomorrow* curriculum and information on reducing polluted runoff. To arrange a presentation, order

publications, or ask questions, contact the Nonpoint Source Education coordinator at 803-898-4300 or visit our website.

South Carolina Water Watch

South Carolina Water Watch is a unique effort to involve the public and local communities in water quality protection. The Water Watch program was developed to encourage South Carolina's citizens to become stewards of the State's lakes, rivers, streams, estuaries, and wetlands. Volunteers select a water resource on which to focus and perform activities aimed at protecting water quality, such as shoreline surveys, public education, and litter cleanups. The Water Watch coordinator assists participants with materials and training to help make projects successful. SCDHEC invites individuals, school groups, civic organizations, businesses, and local governments to learn about and protect the quality of our waterways by contacting the Water Watch coordinator at 803-898-4300 or visit our website.

Champions of the Environment

Champions of the Environment is a student recognition program that raises awareness of environmental issues. Nationally recognized for its innovative approach to environmental education, the program promotes hands-on learning by recognizing students working on exemplary environmental projects beyond the realm of the classroom. With scholarships and media coverage, Champions of the Environment encourages student initiative and self-esteem. The program promotes environmental awareness, leadership, conservation, creativity, and self-confidence through activities such as group projects, public speaking, and environmental research. Champions of the Environment is jointly sponsored by Dupont, International Paper, WIS-TV, and SCDHEC. For more information contact the Champions of the Environment coordinator at 803-898-4300 or visit our website.

Clean Water State Revolving Fund

Congress created the Clean Water State Revolving Fund (SRF) in 1987, to replace the '201 Construction Grants program. In doing so, 'state banks' were created to lend money for virtually any type of water pollution control infrastructure project. Project types include construction of wastewater treatment systems and nonpoint source pollution control. The interest rate on the loans is always below the current market rate. As repayments are made on the loans, funds are recycled to fund additional water protection projects. The vast majority of the SRF funds have been used for the construction of traditional municipal wastewater treatment systems. Because of its inherent flexibility, the SRF program is well suited to accommodate the watershed approach.

SRF loans are available to units of state, local, and regional government, and special purpose districts. South Carolina law prevents loans from being made directly to private organizations and individuals. Local governments such as cities and counties and other units of government such as Soil and Water Conservation Districts, Councils of Government, and Water and Sewer Districts are encouraged to apply for SRF loans for nonpoint source projects. Nonpoint source projects may include construction and maintenance of stormwater management facilities, establishment of a stormwater utility, purchase of land for wetlands and riparian zones, and implementation of source water protection

assessments. For more information, contact the State Revolving Fund coordinator at 803-898-4300 or visit our website.

Citizen-Based Watershed Stewardship Programs

Throughout the Broad River Basin, water quality is a common interest among citizen groups. The issues and membership of these groups vary widely. Some of the citizen groups interested in water quality in the Broad River Basin are described below.

Friends of Lawsons Fork Creek

The Friends of Lawsons Fork Creek is a citizen advocacy group, founded in 2001, working on behalf of the creek. The group does regular water sampling, sponsors river clean-ups, and hosts events to bring attention to Lawsons Fork Creek. The Friends, which operates under the auspices of the Spartanburg Conservation Endowment SPACE, meets monthly to discuss issues relating to the creek. In 2000, the creek was the subject of a book, The Lawson's Fork: Headwaters to Confluence.

The Scenic Broad River Advisory Council

The 15.3 mile stretch of the Broad River, from 99 Islands Dam to its confluence with the Pacolet River, was designated a Scenic River on May 31, 1991. An advisory council was formed consisting of landowners and representatives from industry and state and local governments. This group published a management plan in August 1993. The advisory council is currently updating the plan that provides recommendations for the management of the Scenic Broad River.

Lake Bowen Home Owners and Boaters Association

The Lake Bowen Home Owners and Boaters Association is a non-profit organization dedicated to promoting a safe and enjoyable environment on and around Lake Bowen by educating the public about safe boating and swimming practices and good environmental practices.

Gilder Creek Watershed Association

The Gilder Creek Watershed Association was organized in 1998 and consists of interested citizens in the watershed. The primary goal of the association is the promotion of more stringent county-level regulation of storm water runoff, chiefly for flood control.

Lovers of the Enoree

Originally founded as a Water Watch group, the Lovers of the Enoree group tries to bring attention to water quality issues concerning the Enoree River. A main focus area for the group is promoting the appropriate use of Best Management Practices (BMPs) on construction sites to help reduce sediment runoff.